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EARTHQUAKE RESISTANT RCC AND FERROCEMENT CICULAR COLUMNS WITH MAIN CROSS SPIRAL REINFORCEMENT

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ABSTRACT

In present theory and practice of design of circular columns the main steel is provided along the longitudinal (vertical) direction of the column. But the replacement of this form of main reinforcement in to the cross spiral/helical form will lead to increase in its load carrying capacity by enhancing its ductility and earthquake performance.

KEYWORDS: Column, Cross Spiral Reinforcement, Helical Reinforcement, Ductility, Earthquake Performance

INTRODUCTION

A concrete is a mixture of cement, sand, aggregate, and water with or without admixtures. Such concrete is having good compressive strength thereby it resist the compressive forces effectively, but it is very weak to resist the tensile forces and also it is brittle in nature. So the steel reinforcement is used in concrete to take the tensile forces by enhancing the ductility of the structure. Such reinforced concrete is in use for various constructions. In the present theory and practice of construction and design of circular reinforced concrete columns the main steel is used in the longitudinal direction and to keep this main reinforcement in position the one spiral/helical reinforcement is used. The load in such columns is transferred through longitudinal steel reinforcement and concrete. The most of the load is carried by the longitudinal steel reinforcement. The load carried by the concrete is negligible. But if we neglect the load carried by the concrete then the role of concrete remains only to keep the main steel in position just to increase the moment of inertia sothat it will carry the maximum load. The circular columns with helical reinforcement have greater ductility or toughness when loaded concentrically or with small eccentricity. So it should be noted that since the helically reinforced columns are very ductile as compared to columns with lateral ties, they are more desirable in highly seismic zone. Columns with one helical reinforcement take more load than that of tied columns due to additional strength of spirals in contributing to the strength of columns. Accordingly, cl. 39.4 IS 456-2000 recommends a multiplying factor of 1.05 regarding the strength of such columns. The code further recommends that the ratio of volume of helical reinforcement to the volume of core shall not be less than 0.36 (Ag/Ac – 1) (fck/fy), in order to apply the additional strength factor of 1.05 (cl. 39.4.1. IS 456-2000). Accordingly, the governing equation of the spiral columns may be written as

$$Pu = 1.05(0.4\ fck\ Ac + 0.67\ fyAsc)$$

Earlier observations of several investigators reveal that the effect of containing holds good in the elastic stage only

and it gets lost when spirals reach the yield point. Again, spirals become fully effective after sapling off the concrete cover over the spirals due to excessive deformation. Accordingly, the above two points should be considered in the design of such columns. The first point is regarding the enhanced load carrying capacity taken into account by themultiplying factor of 1.05. The second point is maintaining specified ratio ofvolume of helical reinforcement to the volume of core, as specified in cl.39.4.1 IS 456-2000. As the further increase in diameter of spiral reinforcement the load carrying capacity will further increase beyond 5%. And one stage will be reached the maximum load will be carried by the spiral reinforcement. In present theory and practice the main reinforcement in circular is designed and provided along the longitudinal direction along with one helical reinforcement. And in such cases as per code the increase in strength of such columns is 5%. But if the main reinforcement is designed and provided in two croiss spiral/helical form with larger bar diameter along with one circular layers of smaller bar diameters along the longitudinal direction. The spirals are to be provided on either side of the longitudinalreinforcement will lead to improve its ductile behavior and such columns can be used in high seismic zone.The replacement of such main steel in to the two crossspiral/helical form leads to increase in its load carrying capacity by enhancing its ductility and earthquake performance. The main steel should be used in the two cross spiral form having bigger diameter spiral bars and just to keep this main steel in well positon the vertical bars of smaller diameters can be used in between the two cross spirals so that it will carry the maximum load by increasing its load carrying capacity by the additional pipe action. The diameter of spiral reinforcement ranges from 12mm to 32 mm and the diameter of vertical bars may vary from 6mm to 8mm. Also the number of spirals may vary according to the requirement and provided cross to each other so that there will be additional truss action.Two cross spiral should consist of one layer of small diameter bars in between the two spirals along the longitudinal direction. The strength of such column can be further increased by the principle of ferrocement just by wrapping the welded mesh of diameter 1mm to 3mm.around the periphery of spiral reinforcement and replacing the concrete by mortar.

CONCLUSIONS

- More load carrying capacity
- Better earthquake performance
- More ductile.
- Economical if earthquake forces are taken into account.

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